Space Weather Technical Forecast

Issued on Tuesday, 31 May 2022 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance (10%) of M-class flares. Active electron fluence expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with one C-class flare emanating from ex-3019, a faded, now plage region in the northwest quadrant. The flare was associated with a filament eruption and this is not expected to be Earth directed. AR3025 (Cao/Beta) and a new unnumbered region (Bxo/Beta) located in the far northwest quadrant have not given any significant activity. Two alpha regions in the southeast, 3023 and 3024, appear to be relatively benign. No Earth directed CMEs have been observed in coronagraph imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, has remained around 550km/s over the last 24 hours as the Earth progresses through the high speed stream from coronal hole 84. Density has been close to average throughout this time. Total magnetic field strength has been weak, with the north-south component varying weakly. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels throughout the past 24 hours. The high energy electron flux (greater than 2 MeV) was at moderate to high levels through the period, reaching 4570 pfu at 30/1600 UTC. Electron fluence continued to build, reaching 1.66e8 integrated pfu at 31/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Very Low, with a slight chance (0%) of M-class flares. Initially this will be due to AR3017 just beyond the western limb, but also due to returning region ex-3006 which is currently rotating onto the eastern limb.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 28 May could give a glancing blow to the Earth on day 2 (1 June), but with low confidence and low probability. Earth is currently transitioning through the high speed stream from coronal hole 84, with this expected to decline by day 2 (01 June). No further high speed streams are then expected to connect with Earth until the end of the period when the HSS associated with the next coronal hole CH86 is likely to connect. Geomagnetic activity is likely to be Quiet with isolated Unsettled spells. There is a risk of Active or G1/Minor Storm intervals through day 2 (1 June) in any sustained periods of negative Bz and the chance of a CME arrival.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period. High energy electron flux (greater than 2MeV) is likely to continue at moderate to high levels, with a likelihood of more persistently high (1e3 pfu) levels continuing. Electron fluence levels are forecast to follow an increasing trend and

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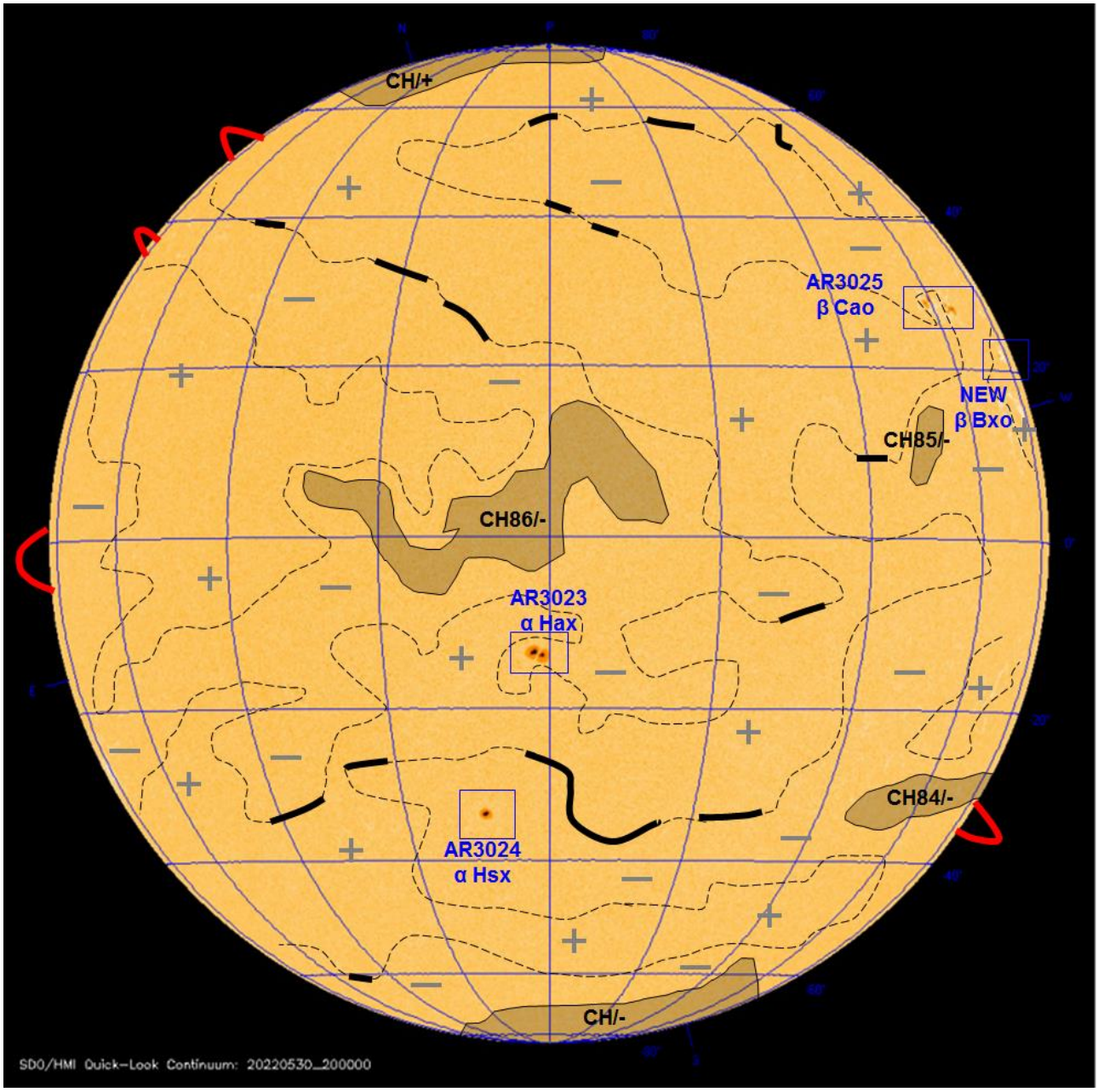
are expected to be above the Active (1e8 integrated pfu) threshold for much of the period.

Figure 1. Solar Analysis Valid 2000UTC, 30 May 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

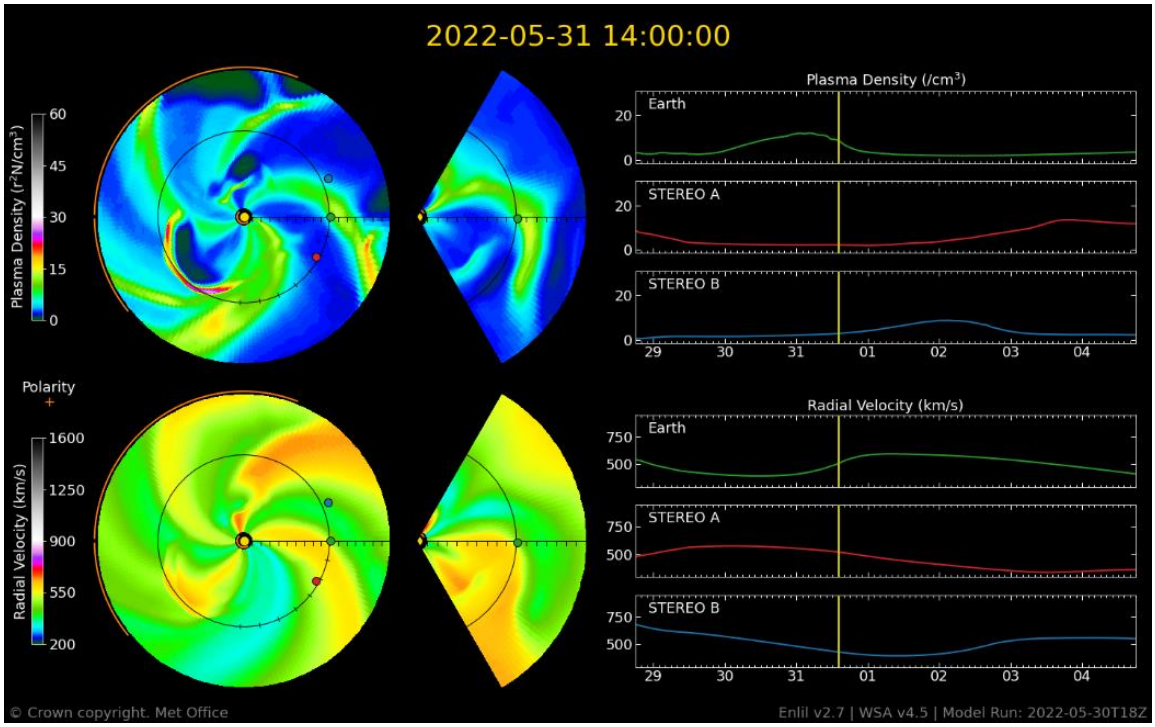
A CME which left the Sun on 28 May is due to pass to the south of the Earth on day 2 (1 June), and there is a slight chance of a glancing blow. Earth is currently in the high speed stream from coronal hole 84 with solar winds elevated at between 500-550km/s. This is then due to decline through the next two days, as the coronal hole rotates around the western limb. No further coronal holes are due to connect during the forecast period. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells. There is a risk of Active or G1/Minor Storm intervals through days 1 and 2 in any sustained periods of negative Bz, and due to the slight chance of the CME arrival on 1 June.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office ENLIL model output with various CMEs which are mostly not directed towards the Earth.



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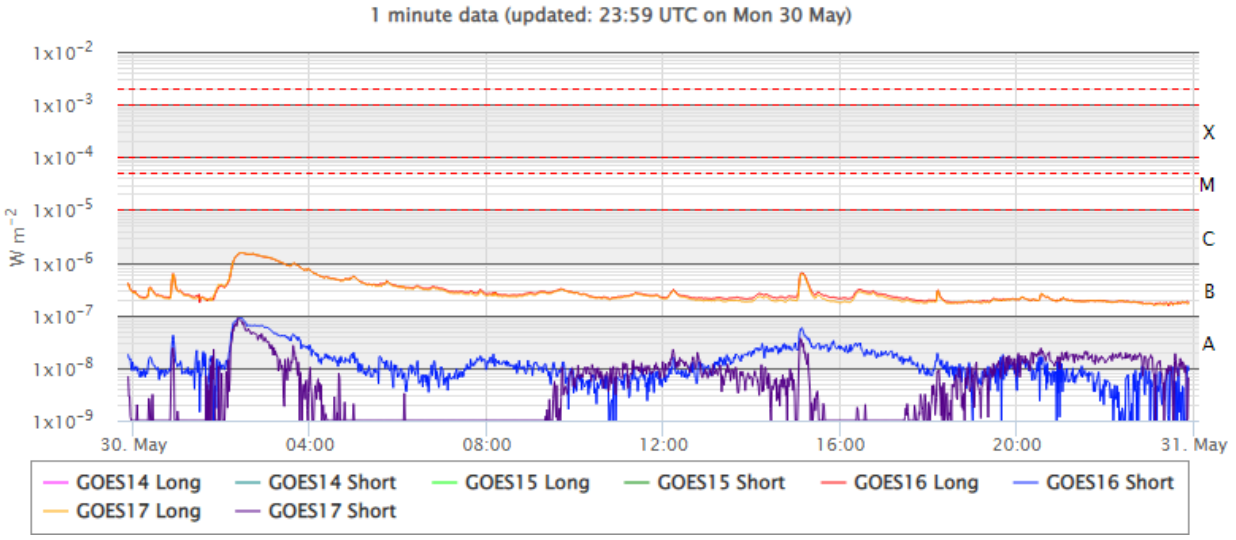
Radio Blackouts - X-Ray Flares:

Solar activity is expected to be Low or Very Low over the next four days, with no significant active regions on the visible disc. AR3025 (Cao/beta) has not produced any significant flare activity. A new region about to rotate off the northwest limb is classified as Bxo/Beta. Ex-3019 produced a filament eruption and a C1.5 flare that led to a CME and this is not Earth directed. Ex-3017, beyond the western limb is now considered to be a low risk for any flares from beyond the limb. A new region rotating across and onto the southeast limb corresponds to ex-3006, which produced an X1.5 flare on the previous rotation and may have been responsible for a recent large far-sided CME. Based on the potential risk from this region, the probability for M-class flares may be raised slightly above that suggested from the raw probabilities associated with the visible active regions in coming days.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux plot from GOES satellites with little activity in the past 24 hours.



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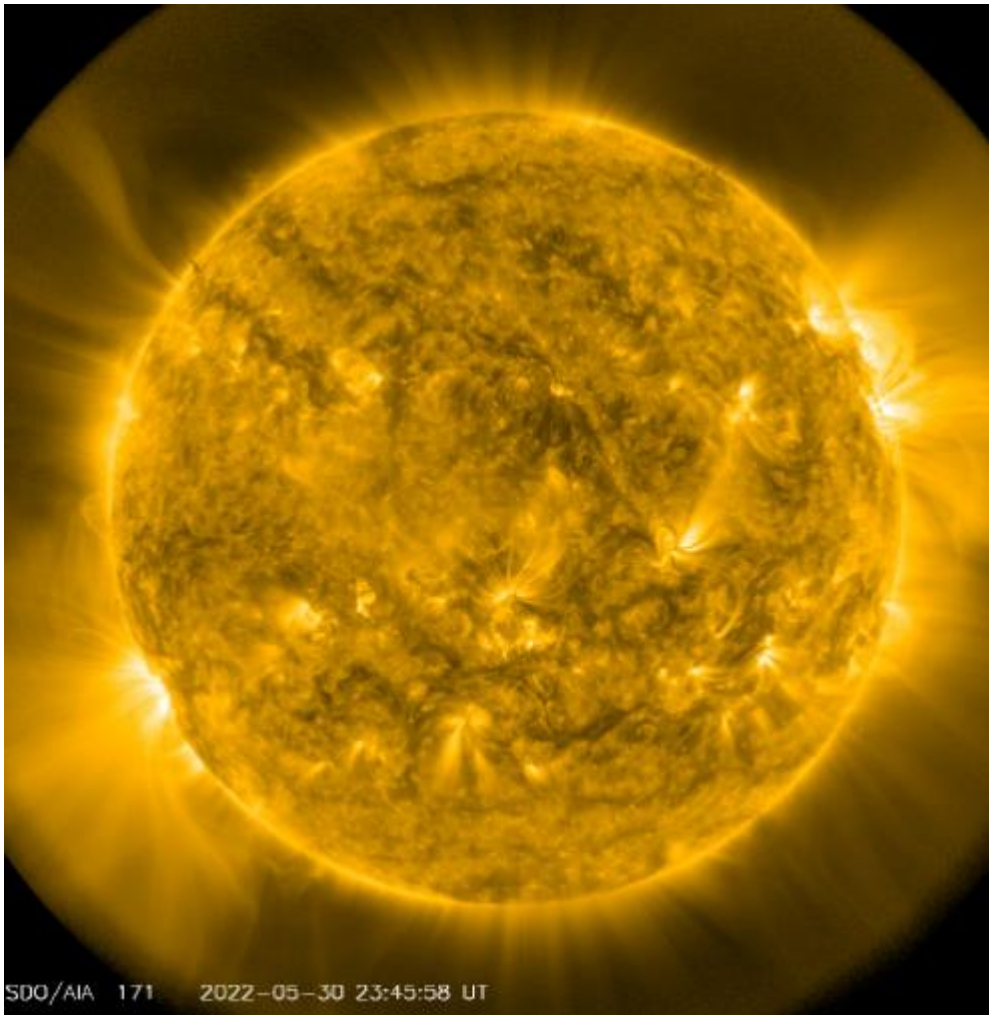
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period. The return of ex-3006 may lead to an elevated risk, and this is currently a region to be more closely monitored for significant activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO aia-171 imagery showing little in the way of significant activity on the visible disc currently.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) values are currently at moderate and high levels, with a recent sharp rise probably related to effects from the high speed stream on the shape of the radiation belts. Periods of enhanced geomagnetic activity may also be causing displacement of electrons within the belts. The high speed stream is due to subside by day 2 or 3 (1 or 2 June) which may result in the electron flux reaching higher levels on diurnal highs and also maintaining a higher average value between peaks.

Electron fluence continues to rise sharply with fluence levels probably remaining above the Active (1e8 integrated pfu) threshold for much of the forthcoming guidance period as a result of the increase in electron flux levels.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	70	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	10	20	10	5

Figure 5: High energy electron flux and Fluence at GEO with a marked increase in the past couple of days.

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